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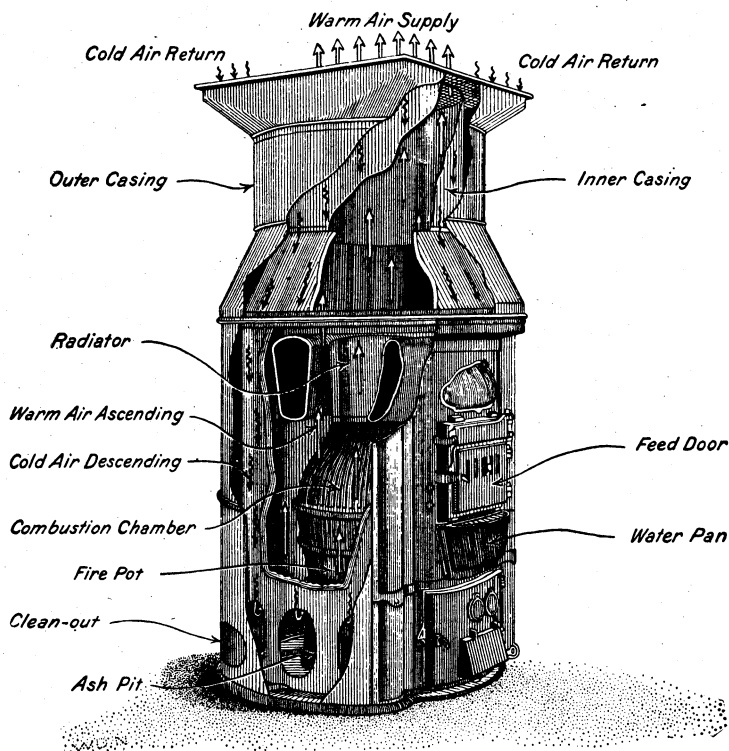
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# ONE-REGISTER FURNACES

## (PIPELESS FURNACES)

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Typical One-register Furnace

FARMERS' BULLETIN 1174  
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Contribution from the Bureau of Public Roads  
THOS. H. MacDONALD, Chief

Washington, D. C.

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**T**HIS bulletin discusses the principles and the advantages and disadvantages of the one-register warm-air house heating system. It is not the purpose to recommend this system in preference to others but to present the facts in order to assist the householder in selecting a heating system that will give the best service and most satisfaction for the money expended.

The system of warm-air heating treated in this bulletin is that in which all the heat is supplied through one register. It has come into much favor during the last few years. It is known by a variety of names, one-pipe, pipeless, one-heater, single-heater, one-register, or single-register, and not infrequently by the name of the manufacturer of the furnace. This bulletin explains the system, illustrates the circulation of cold and warm air in the rooms, and points out conditions under which satisfactory service can be expected.

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## PRINCIPLE OF THE SYSTEM.

THE principle of the one-register system of warm-air heating, which has come into prominence during the last few years, is by no means new. Some fifty or sixty years ago a patent was granted for a stove with a jacket around it, to be placed in the basement, which, it was claimed, would deliver enough heat through a single opening in the floor above it to heat an entire house. The original idea, however, provided no means for removing from the rooms the cold air which the heated air must displace in order to warm the house properly. Consequently, success never crowned the efforts of the original inventor.

Subsequent endeavors produced the present one-register furnace, which may be considered, and not improperly, the successor to the base-burner. The single-register furnace is applicable to work that may be accomplished with stoves of large size but its performance is much better. It distributes warm air more rapidly and evenly because it draws away the cold air from the floor.

## CONSTRUCTION OF THE FURNACE.

The typical construction of the furnace is shown on the title page. It consists essentially of a heater with a single register located directly above. The register has two parts, the center portion through which warm air passes upward and the outer portion which conducts the cooler air downward between the outer and the inner casing to the base of the furnace. From there it recirculates upward around the heating surfaces of the furnace and then out again through the hot-air part of the register. The arrows in the illustration indicate the direction of the cold and warm air currents.

Figures 1 and 2 show, respectively, the floor plan and a section through a five-room farmhouse. In this design all rooms are on one floor. This example of a one-register furnace with the warm and cold air outlets located as shown illustrates the air circulation which

must occur to obtain satisfactory heating. Figure 3 shows this type of furnace installed in a six-room, two-story farmhouse. The arrows indicate the desired circulation.

### CIRCULATION OF AIR.

As the heated air leaves the central part of the register it rises straight to the ceiling and diffuses through all the rooms that open into the main room or hall in which the register is located, provided the door openings extend well up to the ceiling and no hangings interrupt the circulation. If there is an open stairway, part of the heat will circulate to the upper hall and enter rooms that open into it. A register placed in the ceiling of a downstairs room under some conditions may offer greater assurance of heating the room directly above if it is desired that the room should be heated to a

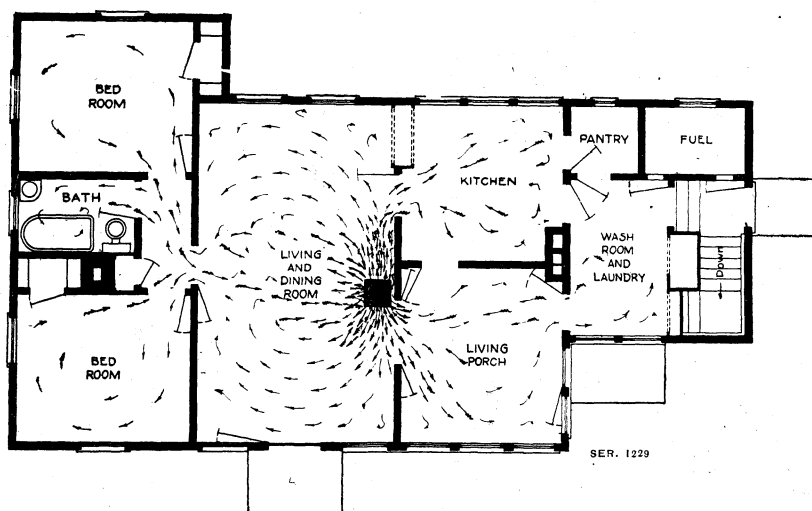


FIG. 1.—Floor plan showing the circulation of warm and cooled air from a one-register furnace.

higher temperature than other second-story rooms. Ceiling registers, however, should not be considered always as warm-air passages; they not infrequently may be cold-air returns. The result depends upon the arrangement of stairways and lower and upper story rooms.

As the heated air diffuses through the house the colder and heavier air falls to the floor. From there it is drawn back continually into the furnace through the return inlets. It is apparent that since all the air circulates through one register, which has a relatively small area as compared to the volume of the house, a concentration must occur at this part of the system. This is sometimes noticeable to one sitting near the register by a circulation of cooler air around the feet; if very uncomfortable, the principal contributing cause may be air from without that flows to the register from under an

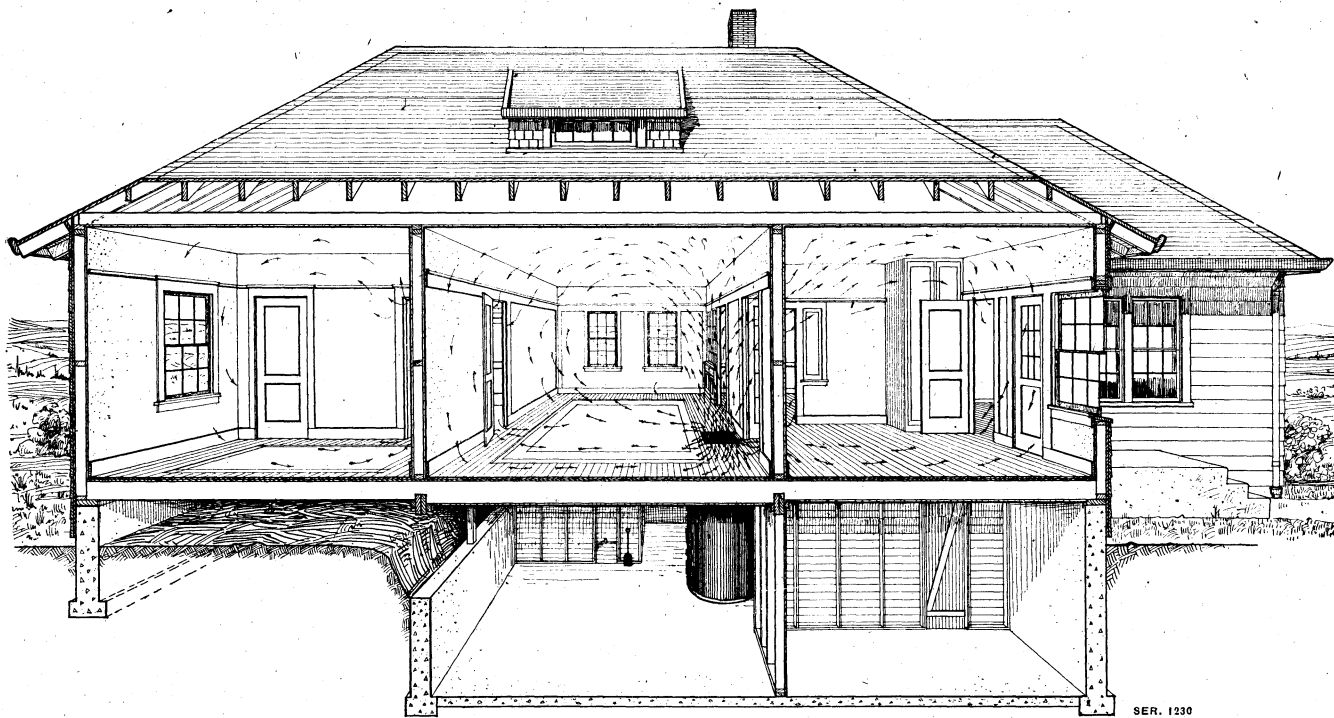
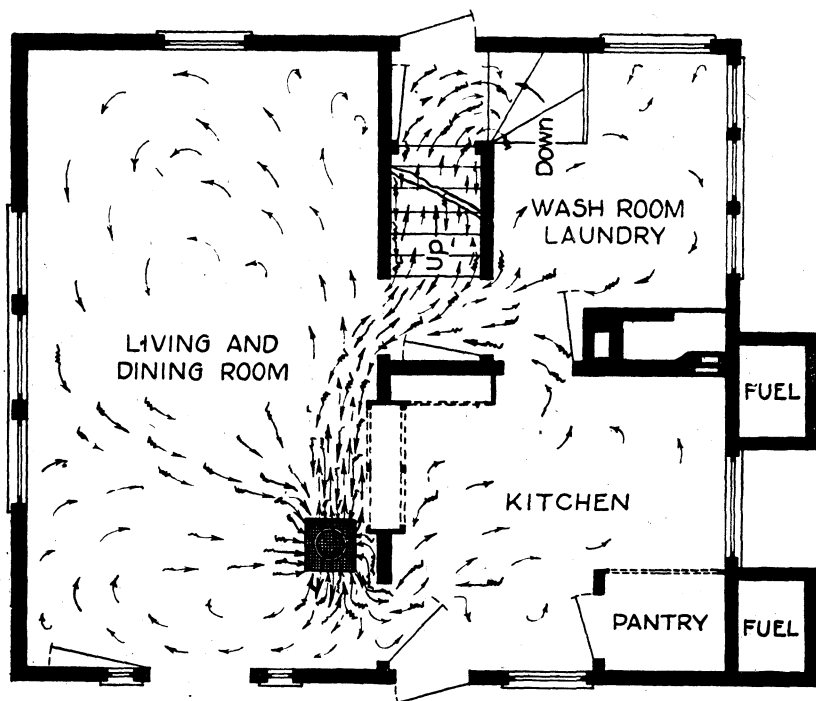
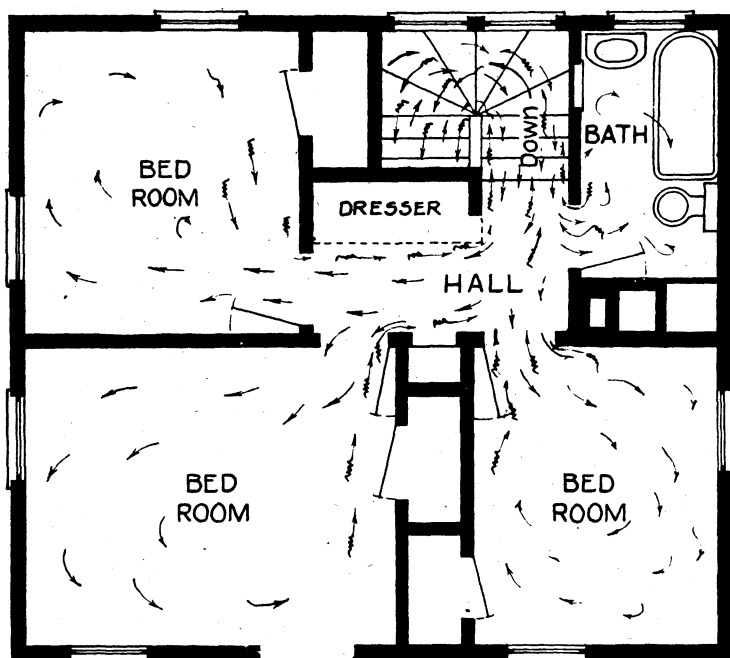


FIG. 2.—Interior view of house showing the circulation of warm and cooled air from a one-register furnace.

SER. 1230



FIRST-FLOOR PLAN.



SECOND-FLOOR PLAN.

SER. 1178

FIG. 3.—Floor plans of a six-room house showing the circulation of warm air and cooled air from a one-register furnace.

outside door or opening in line with the register. By some this draft of cooler air, whether flowing from the inside or outside, is considered a drawback to the system. One might think that the room in which the register is situated would receive too much heat, but experience generally proves that this is not the case. The warm air diffuses quite evenly, producing, usually, a comfortable temperature which at the same level seldom varies more than a few degrees at different points throughout the building, provided the arrangement of the house is suitable for a one-register furnace installation.

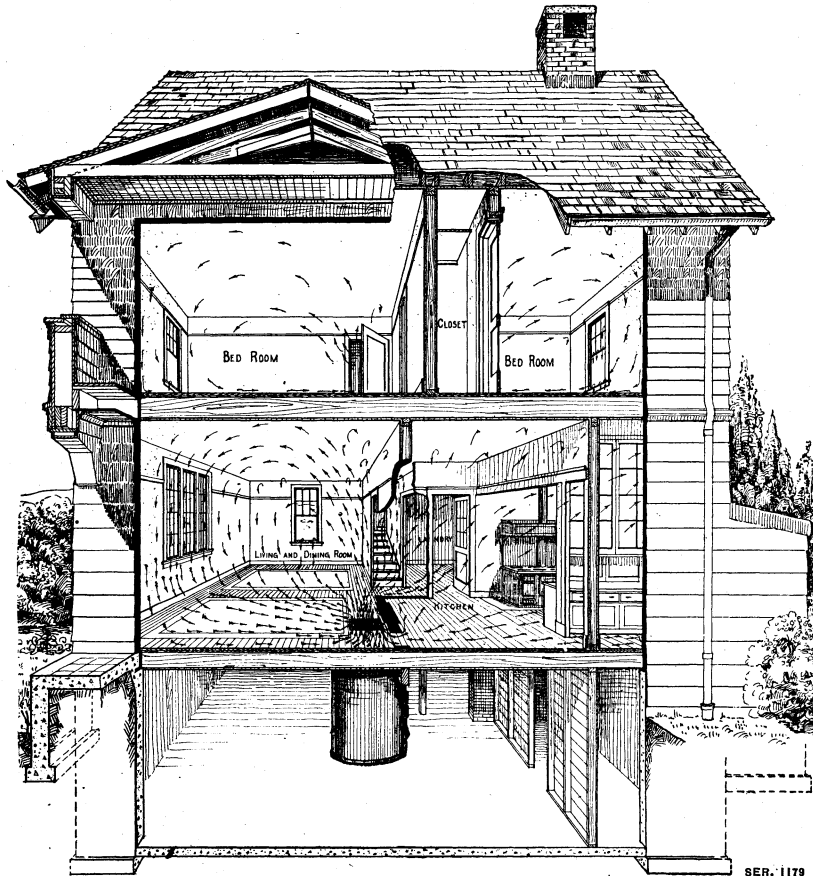


FIG. 4.—Interior view of six-room house, showing the circulation of warm air and cooled air from a one-register furnace.

#### FACTORS AFFECTING ITS SUITABILITY.

It is impossible to describe definitely the conditions under which the installation of a one-pipe furnace should be recommended. There are a number of variable factors. The arrangement of the rooms is very important; there must always be an unobstructed passage for the air from room to room. Nothing must interfere with the air circulation nor divert it from any room that is to be



heated. The number of rooms that may be effectively heated is open to question. A conservative manufacturer generally will not recommend it for any home until he has examined the plans of the house, and he will sell with the reservation that he does not agree to make comfortable rooms which do not open directly into the room where the furnace outlet is located. The following paragraphs are quoted from a "Proposal for heating" used by a large manufacturer of one-pipe furnaces:

In consideration of payment of the purchase price at the time stipulated, we agree and guarantee that this furnace, properly operated, will furnish sufficient heat for all the rooms opening into the main room where the hot-air register face is situated.

It must be understood that the method of heating from one register does not warm all rooms alike, and that rooms shut off from the room where the heating register is placed are not materially influenced by it. By the use of ceiling registers the upper rooms above that where the heat register is situated will be tempered comfortably for sleeping purposes. The main room with the heat register will be warmed without difficulty to a comfortable degree (70° F.) in coldest weather.

Another reliable firm gives a guaranty that "if, after 60 days' trial in cold winter weather the heater is not satisfactory, it can be taken out and returned to the manufacturers, who will, on their part, refund the original purchase price paid for it."

There have been, however, manufacturers of one-register furnaces whose enthusiasm has led them to make apparently extravagant claims for their product, even advertising to heat any house with this type of furnace. While there may be houses of exceptionally large size in which a one-register furnace has been installed and is giving satisfactory service, the fact should be considered as the exception rather than the rule. The requirements of families using a heating system may differ widely. What might be regarded as a satisfactory and efficient single-register furnace by one family by another family might be considered quite the contrary.

In one instance a conservative manufacturer, in spite of the greatest care in selling, with agreements that excepted attempts to heat other than the main living room, found it necessary to replace the one-register furnace by a pipe furnace in houses of five to eight rooms in order to have certain rooms heated to a desired temperature. Contrasted to this is one gentleman who states that his 16-room house, with no storm windows, was perfectly warmed through a severe Vermont winter by a furnace that the manufacturer rated at seven or eight rooms' capacity.

Many families prefer and others demand cool bedrooms, and an apparatus that warms those rooms to a temperature above 50° or 60° F. is not required. On the other hand, some families, especially those in which are elderly or delicate members, require warmer halls and sleeping rooms. Under such conditions particularly the limitations of this system should be considered. In cold winter weather

too much reliance probably should not be placed in a one-register installation if a temperature of 70° and upward is required in second-story bedrooms, halls, bathroom, kitchen, or any rooms that are detached or distant from the main room in which the register is placed.

#### LIMITATIONS OF THE ONE-REGISTER FURNACE.

The one-register furnace is no exception to the rule that everything has advantages and disadvantages and must prove itself before it will receive recognition. When the one-register furnace, as a commercial article, was new many manufacturers were inclined to question the correctness of some apparently extravagant claims that had been made regarding it, although they did not doubt the honesty of the writers. Longer experience has convinced those that then composed the more conservative group that many of the statements were correct in their essential features.

This, however, does not establish the universal suitability of the one-register furnace for all houses, but should rather impress a prospective owner with the advisability of proceeding with as much caution in the purchase of one, as the manufacturers showed in finally indorsing it.

To-day there are perhaps thousands of instances where this system of heating is in operation with complete satisfaction, and where the owner would now consider no other. These cases, however, do not include houses in which one or more rooms are shut off from the others, nor are they often found in one-story houses where the grouping of the rooms is long rather than square;<sup>1</sup> or in two-story houses of more than 8 or 10 rooms where the dimensions of the house exceed a length of about 40 feet and a width of about 30 feet.

Some advocates of this system claim that it has a distinct advantage over the ordinary warm-air furnace for the reason that in the ordinary furnace a pipe 10 inches in diameter, which has an area of slightly more than one-half square foot, must carry all the warm air for each separate room from the furnace, whereas the doorways, through which the heat from the one-register furnace is transmitted, are about 17 square feet in area, approximately 35 times as great as the pipe area. The argument has indeed been used that, instead of carrying the heat through a small pipe, you carry it through the door openings, or rather you do not have to carry it, it simply goes in. This may seem convincing at first thought, but it should be remembered that warm air may be delivered into a room directly from the furnace through a separate pipe at a higher temperature than when it is made to circulate through doorways, for as air circulates from one room to another of lower temperature it becomes cooled; consequently the farther it has to go and the longer it takes

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<sup>1</sup> Some manufacturers do not advise trying to heat over 1,500 square feet of floor space on one floor.

the less heat will it contain when it finally reaches the room farthest from the register. One is more certain, therefore, of obtaining the necessary amount of air at any desired temperature by means of a direct pipe from the furnace.

One of the essential requirements of the system is to install the furnace approximately under the center of the first floor, while for warm-air pipe heating it is considered in the interest of good design to place the furnace nearer the windward side of the house in order to favor the colder side on windy days with shorter pipe runs.

The argument has been advanced that the one-pipe furnace acts as a sort of atmospheric sterilizer by removing dust and germs from the heated rooms. If the circulation is strong enough some particles of dust floating in the rooms are no doubt carried to the furnace, pass through it and are again discharged into the rooms. If much dust is present it will settle on nearby objects, and even discolor walls and curtains, but the air is neither contaminated nor purified by circulating through the heater.

This system does not provide ventilation, since it recirculates the air over and over again and must depend on the opening of doors and windows and on infiltration for its supply of fresh air, though in this it does not differ from most residential hot-water, steam, or vapor plants. Warm-air pipe furnaces, when properly installed, include a fresh-air inlet.

#### MEANS OF HEATING A DETACHED ROOM.

Probably more skepticism has been expressed about the ability of the one-register furnace to heat the bath or other closed or detached room than about any other claim that is made for it. Since the success of the system depends on the transfer of heat from room to room through the doorways, it is clear that the closing of the door of any room other than the one in which the register is located will cut off the supply of heat to that room. If, therefore, the room is one which it is necessary to keep closed, such as the bathroom, it may be necessary to provide other means of maintaining the desired temperature. To remedy this partially, transoms may be provided over the doors. These can then be left open, but an opening should also be left at the bottom of the door. Another plan is to install a hot-water radiator connected with an ordinary range boiler, like the arrangement shown in figure 5; or, if there is sufficient space, and there is no objection to the appearance, the range boiler may be located in the bathroom and connected to a water coil in the furnace, provided the latter has proper openings. The radiation from this boiler is frequently sufficient to heat the room to the desired temperature. Still another method, shown in figure 7, is to use a furnace in which a part is partitioned off and dampered so that the air heated in that part may be directed through a separate pipe to

the bath or other detached room. When heat is not required in that room, it may be directed through the large register by altering the position of the damper. While such a plan is feasible, the system with that arrangement could not properly be classed as a one-register installation.

### ADVANTAGES OF THE ONE-REGISTER FURNACE.

The one-register furnace is a valuable addition to the means of heating houses and, particularly, stores, halls, churches, shops, etc.

It is comparatively simple to install. Installation by a good me-

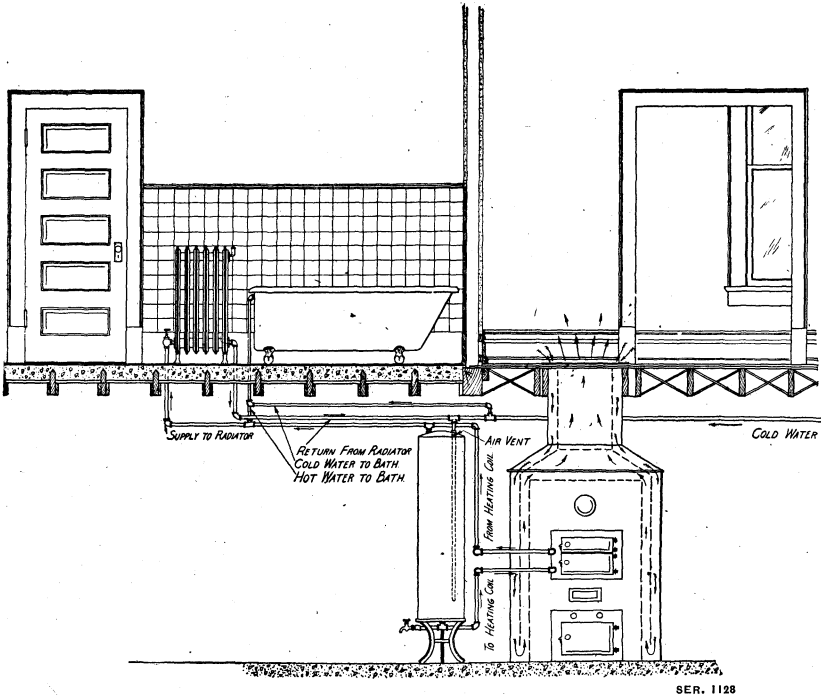


FIG. 5.—Bath and other detached rooms which may necessarily be closed off from the rest of the house can often be heated satisfactorily by using a hot-water radiator in connection with the one-register furnace. When this scheme is used, the safety valve on the boiler should be set so that the pressure in the system will never become excessive.

chanic familiar with the heating business offers greater certainty than if the work is done by an inexperienced person.

The price of a one-register furnace installation is moderate, and within the reach of every householder who can afford a large base-burner of the better sort. Within its field, therefore, it offers to those who heretofore may not have felt that they could afford a heating plant an opportunity to get real heating comfort at a moderate price. It presents a means of heating many old houses in which the installation of a first-class pipe heater would be too expensive to justify consideration.

The cost of operation in nearly all instances is less than that of a warm-air pipe furnace. The cause of this slight difference in its favor is its more perfect insulation in the cellar. The downflowing current of cooled air absorbs the heat given off by the jacket of the heating chamber and carries it down and up again through the warm-air chamber and thence into the rooms above, whereas in the ordinary type of warm-air heater the heat radiated by the casing of the heating chamber is dissipated in the cellar unless the heater is covered with insulation. Also, the circulation of air over the

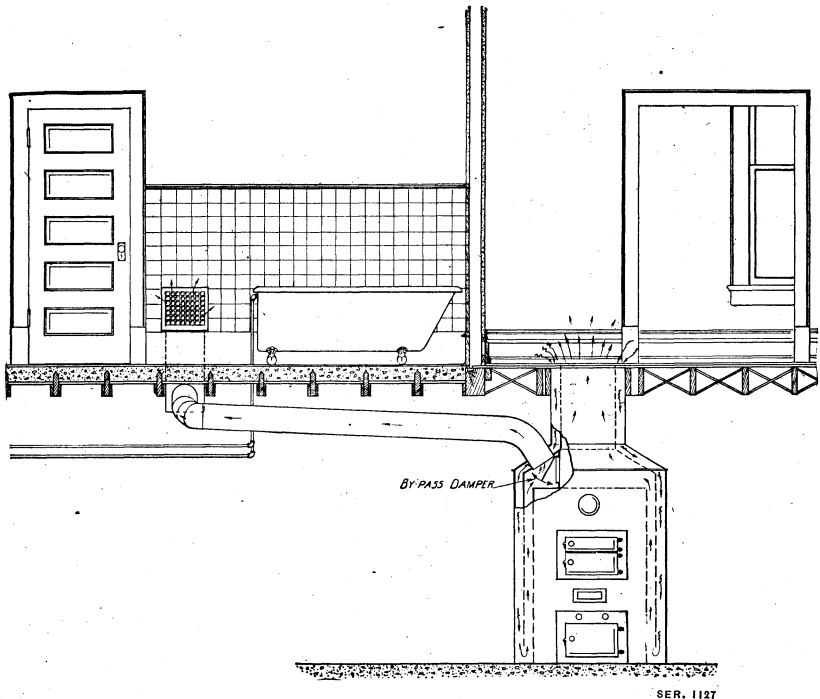


FIG. 6.—The same result as illustrated by fig. 5 may be accomplished by using a partitioned heater. The installation then can not properly be classed as a one-pipe furnace.

heated castings is much more rapid, as the discharge is directly upward without the resistance due to friction in pipes.

A one-register heater may replace two or three stoves. It offers a more easily regulated heat, and requires no dismantling in the spring and reinstalling in the fall. The number of fires to take care of is reduced to one, and all handling of fuel and ashes is confined to the basement.

There is no doubt that, for conditions to which it is suited, the one-register furnace system is both efficient and satisfactory, but to secure an effective installation it is sometimes necessary to sacrifice architectural or decorative effects which generally are accepted as desirable.